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Yano et al.

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[54] **APPARATUS FOR MOLDING ROOFING PANELS HAVING A STEPPED PORTION**

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Feb. 2, 1977 [JP] Japan 52-11090

[51] **Int. Cl.**[2] **B28B 1/29;** B28B 3/00
[52] **U.S. Cl.** **425/219;** 425/412
[58] **Field of Search** 425/218, 219

[56] **References Cited**

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Primary Examiner—J. Howard Flint, Jr.
Attorney, Agent, or Firm—Armstrong, Nikaido, Marmelstein & Kubovcik

[57] **ABSTRACT**

An apparatus for molding roofing panels having an insert portion extending from one end of the main body of the panel and offset stepwise from the surface of the main body. The apparatus comprises a lower die divided into a die segment for forming the insert portion and a die segment for forming the main body which have cavities conforming to the shapes of the insert portion and the main body of the panel respectively, and a movable hopper disposed to the front of the insert portion die segment and adapted to feed a material in a specified thickness. The main body die segment is initially held in its raised position with the bottoms of the two die segments positioned at the same level, and the movable hopper is reciprocated to feed the material into the combined cavity of the lower die to a uniform thickness. Subsequently an upper die is lowered into the lower die cavity to press the material, with the main body die segment also lowered by the amount of the offset of the panel insert portion. The insert portion and main body of the roofing panel thus formed are substantially equal in thickness.

7 Claims, 10 Drawing Figures

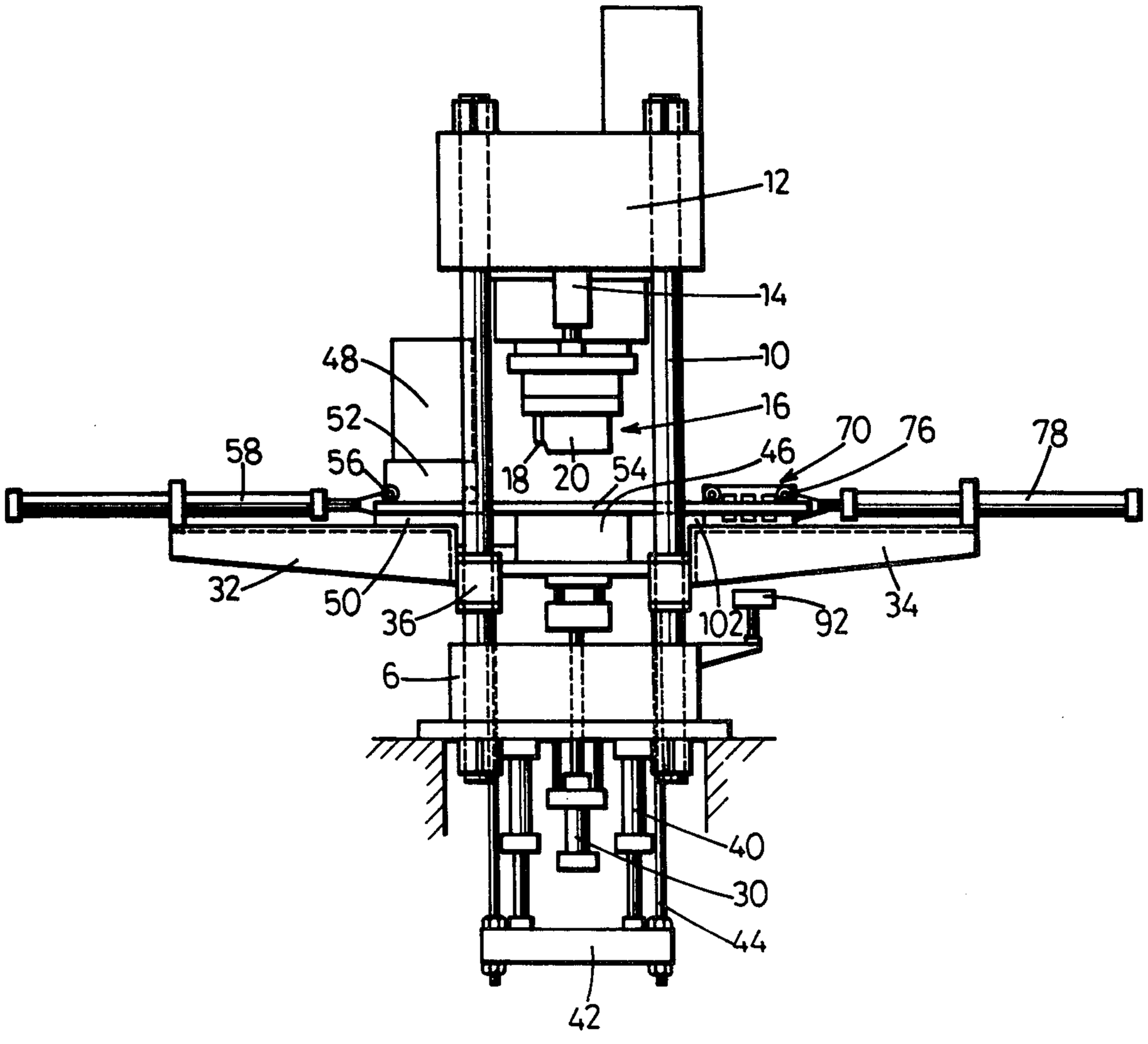

FIG.1

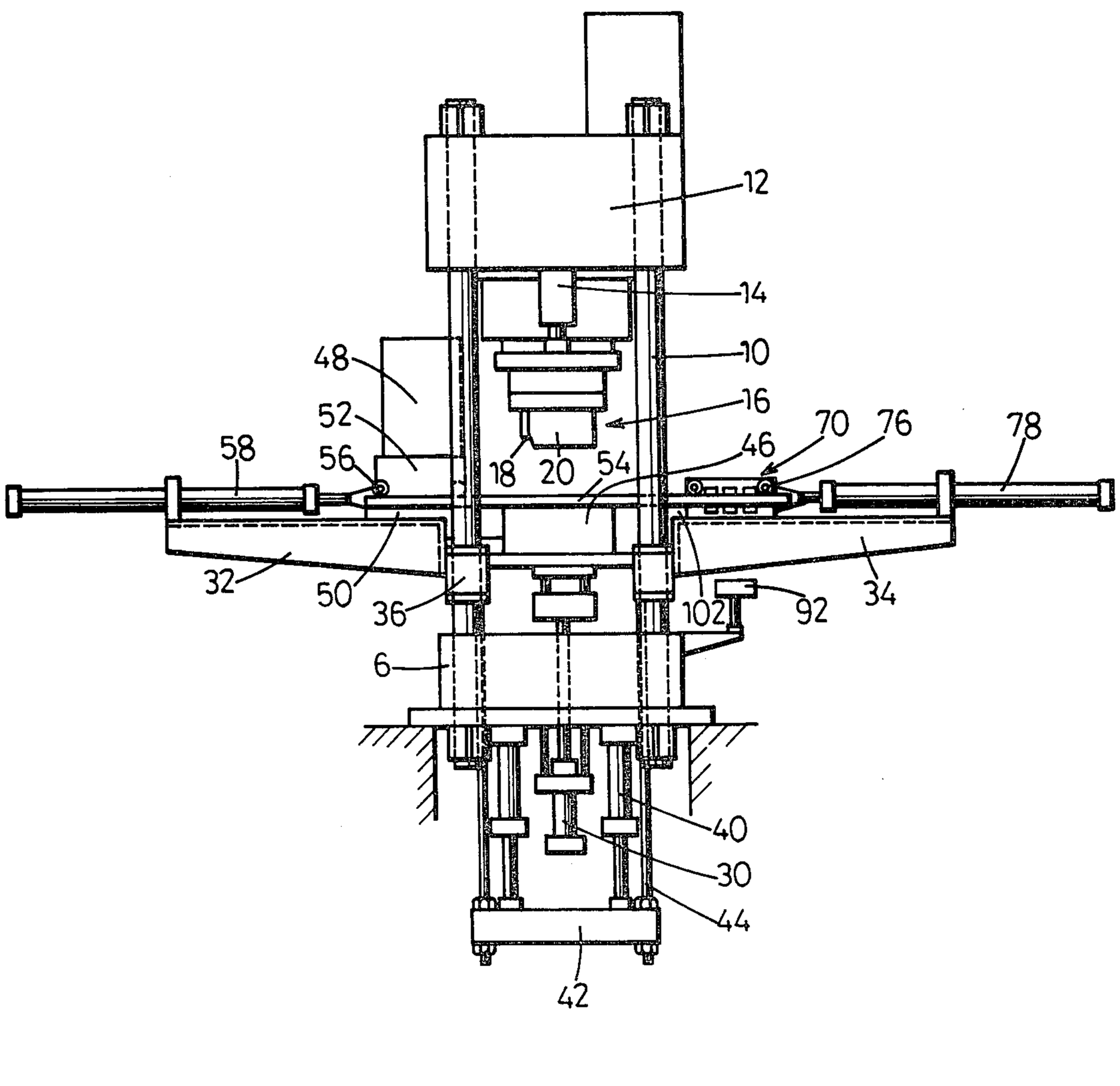
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FIG.2

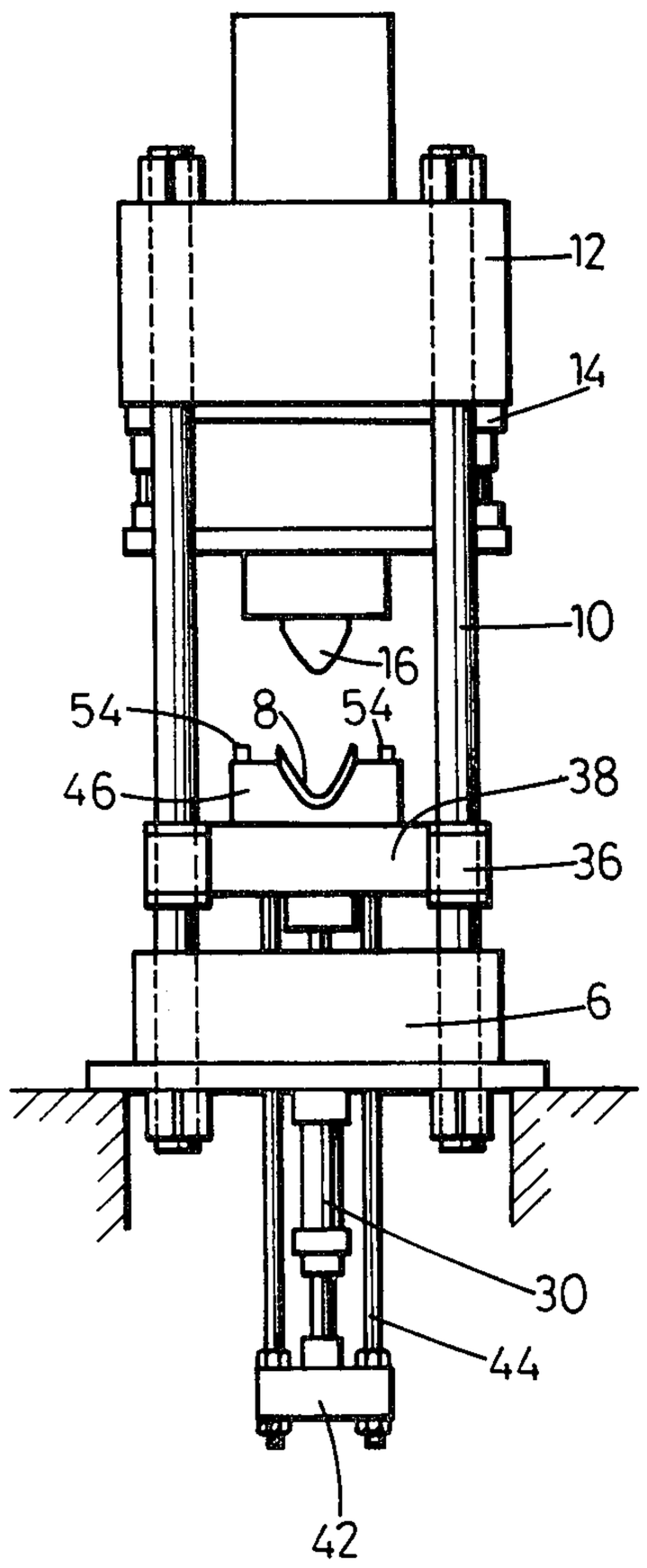
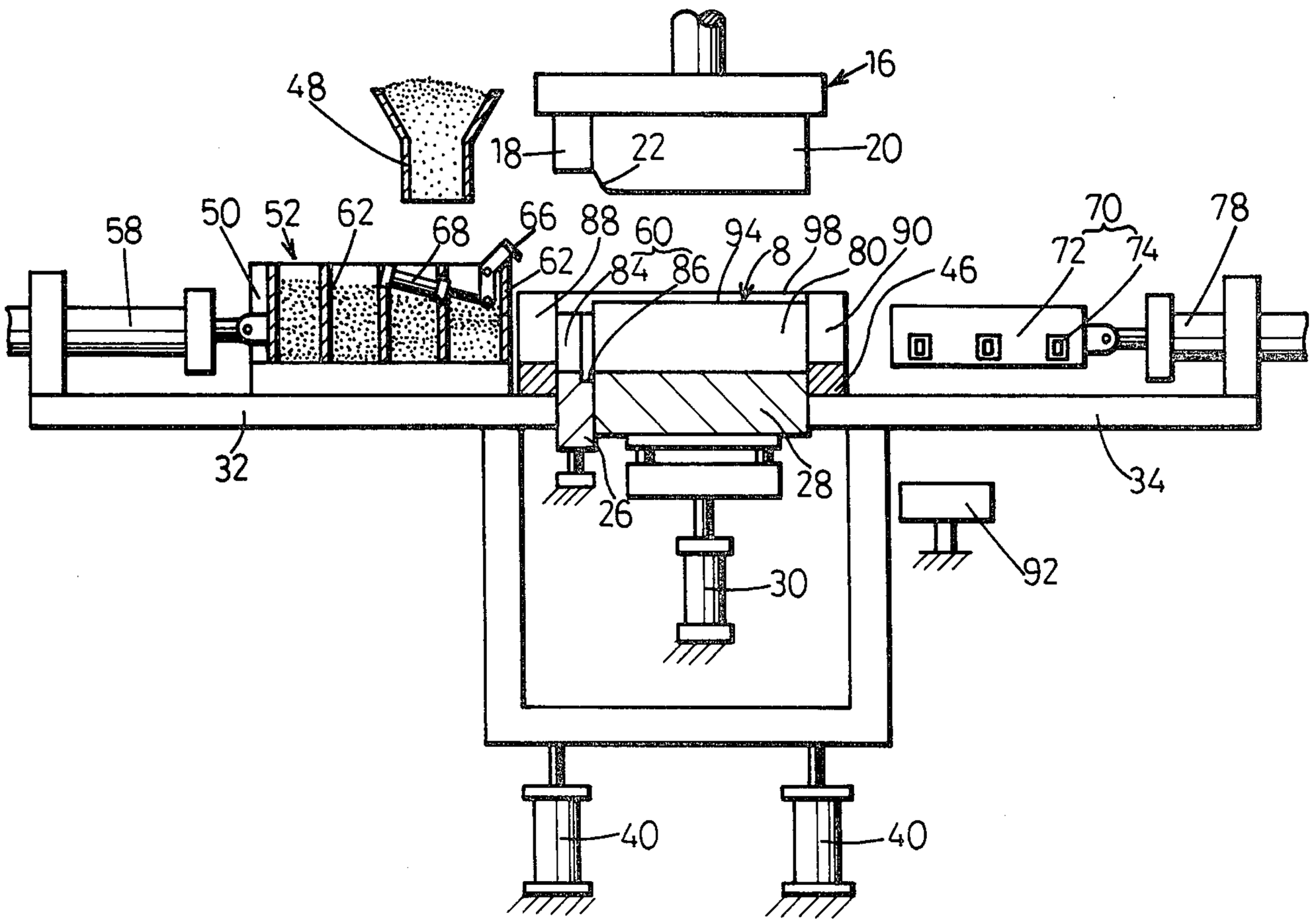


FIG.3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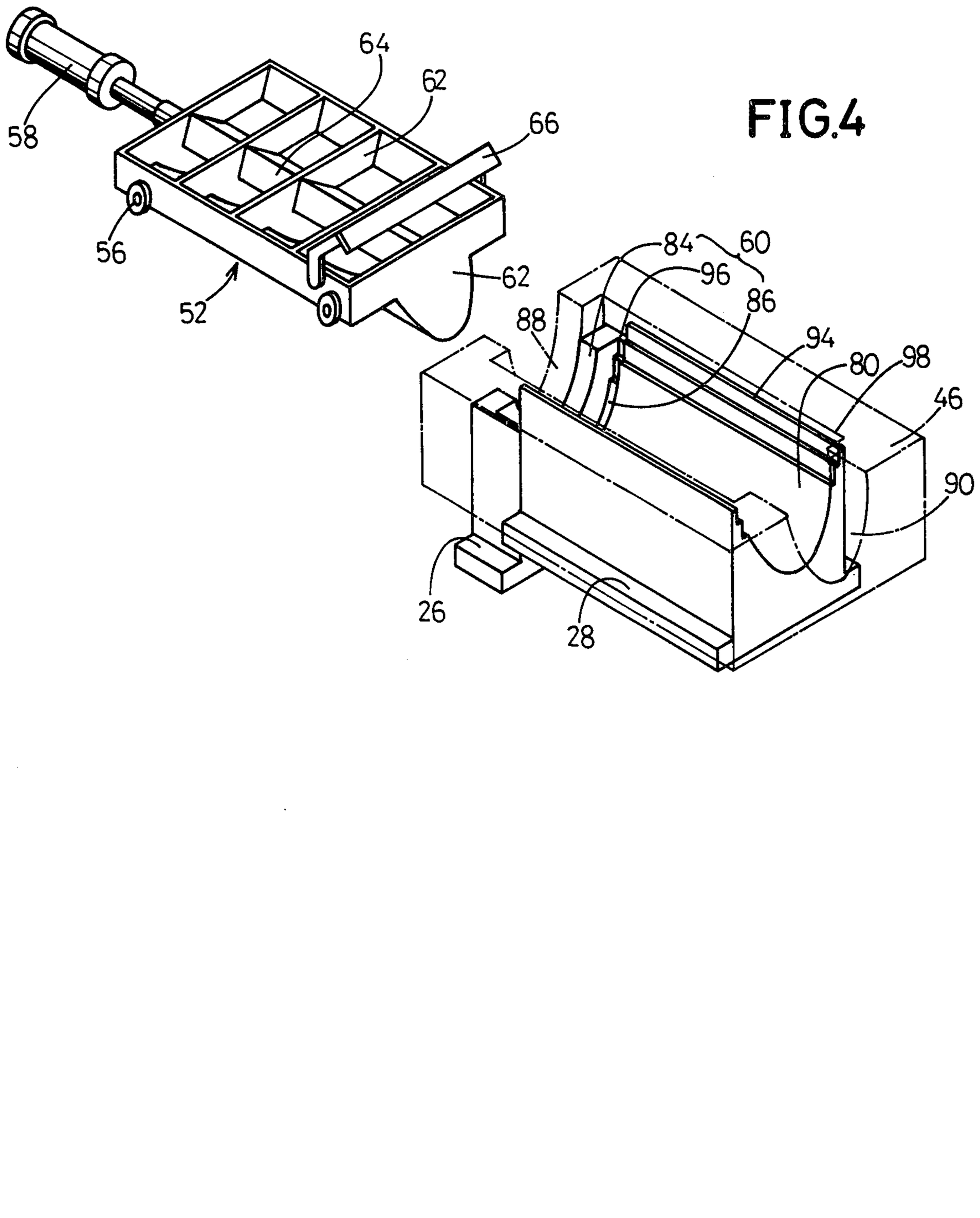


FIG.4

FIG.5

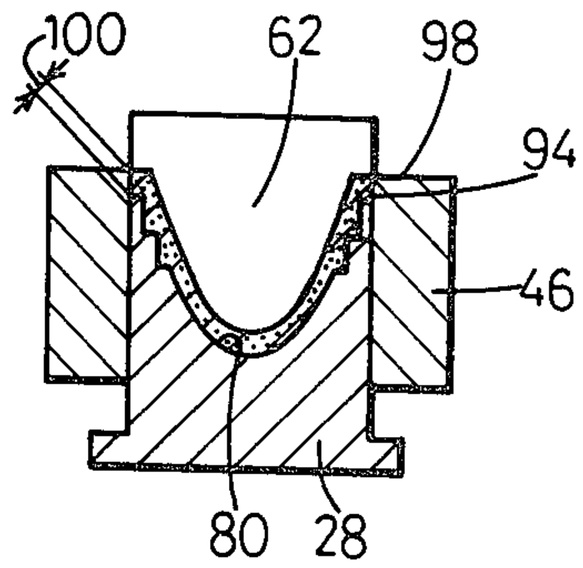


FIG.9

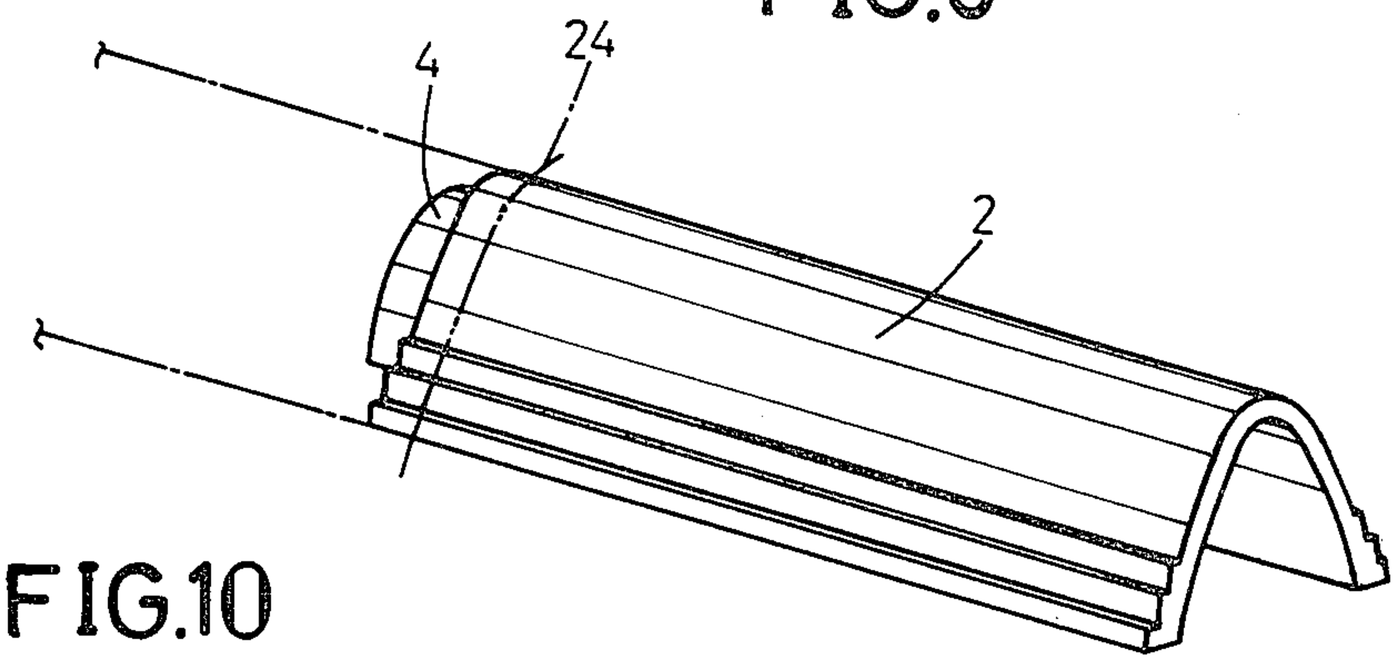


FIG.10

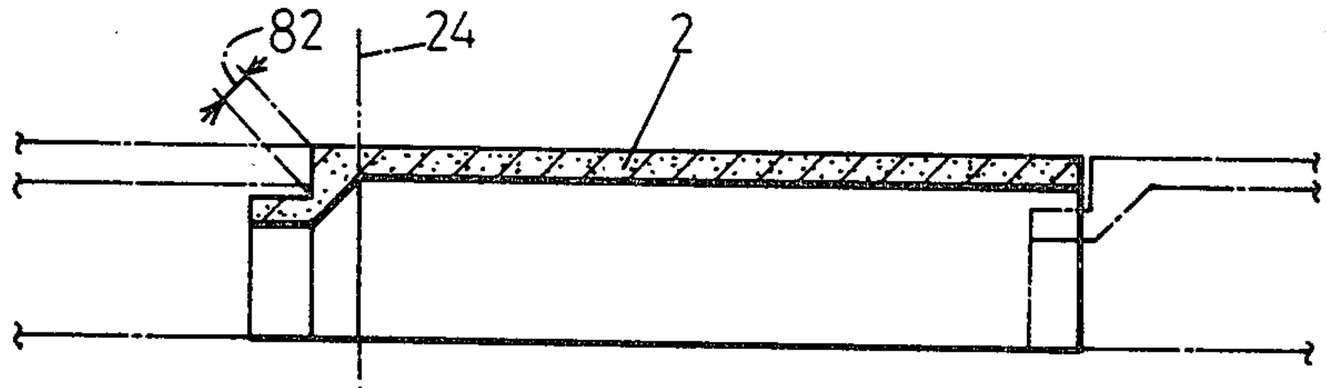


FIG.6

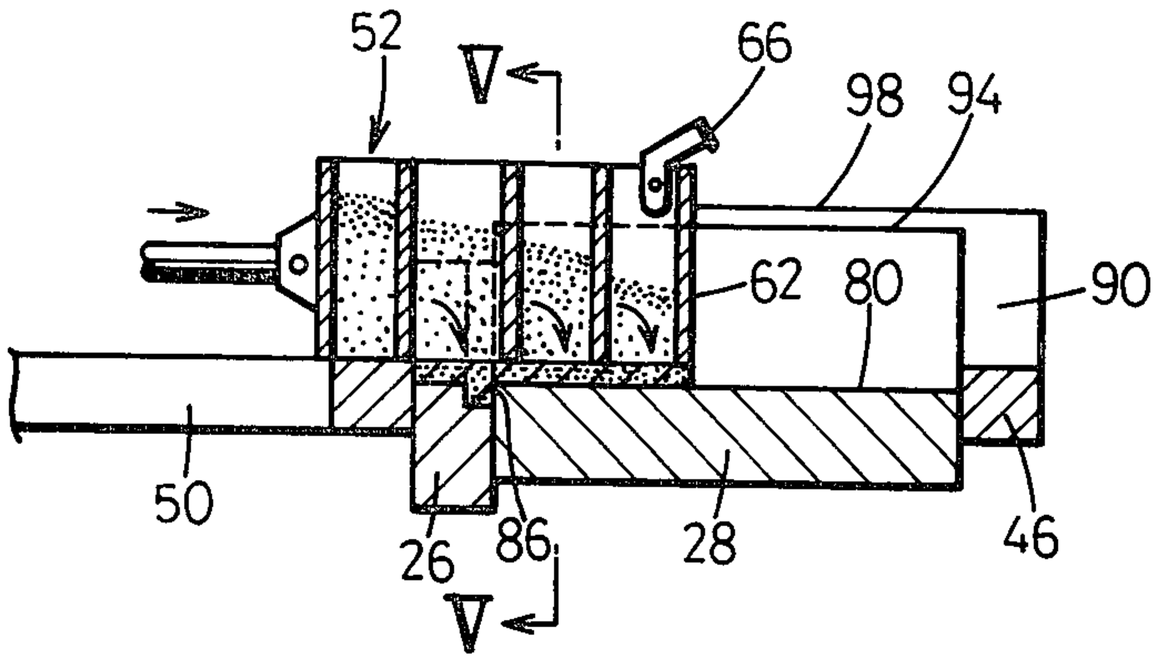


FIG.7

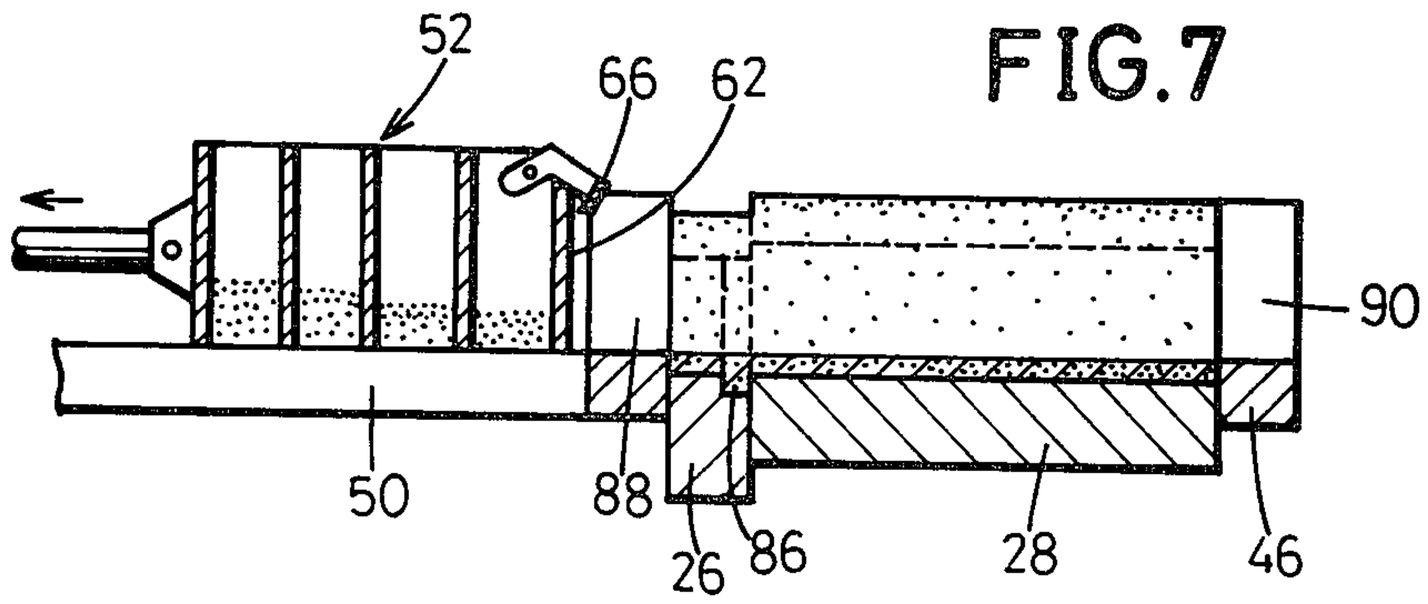
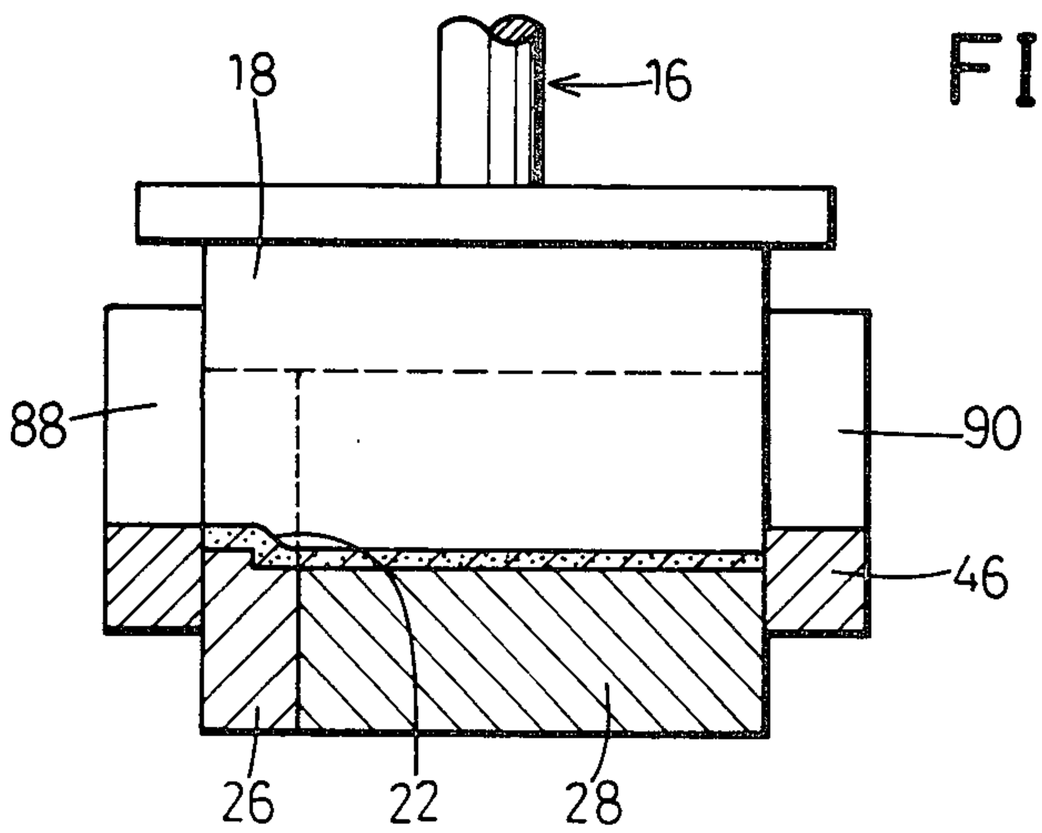


FIG.8



APPARATUS FOR MOLDING ROOFING PANELS HAVING A STEPPED PORTION

BACKGROUND OF THE INVENTION

Cement roofing panels are usually made from a mixture of cement and sand in the ratio by weight of 1:3 by adding water to the mixture to prepare a flowable mortar, press-molding the mortar on a die board and curing the resulting moldings. However roofing panels obtained have the drawbacks of being heavy, having insufficient heat-insulating properties and being prone to cracking during curing.

The present applicant (or assignee) has previously invented lightweight roofing panels made from a mixture of cement and an inorganic foamed aggregate such as pumice, foamed siliceous sand or the like by adding a small amount of water, i.e. about 3 to 15% by weight of water based on the mixture, to wet the starting mixture, placing the mixture into molds, and pressing the mixture at a pressure of 200 to 600 kg/cm^2 and curing the molded pieces. Since the inorganic foamed aggregate remains porous as incorporated in the cement roofing panels obtained by the dry method, the panels have the advantages of having a reduced specific gravity, being lightweight, possessing improved heat-insulating properties and being less susceptible to cracking during curing.

This invention relates to an apparatus for molding roofing panels by the dry method described above, and more particularly to an apparatus for producing roofing panels, as shown in FIGS. **9** and **10**, which include a main body **2** and an insert portion **4** extending stepwise from one end of the main body **2**, the main body **2** and the insert portion **4** having substantially the same thickness.

Such roofing panels having a stepped portion are adapted for use on the ridge of roofs as arranged continuously in a row as illustrated in FIG. **10**, with the insert portion **4** of each panel fitted to the other end of the adjacent panel. Roofing panels of this type are not limited to the illustrated arched panels but include those L- or V-shaped in cross section, those in the form of a flat plate, etc. The molding apparatus of this invention is useful for the production of various kinds of roofing panels having a stepped portion.

SUMMARY OF THE INVENTION

An object of this invention is to provide an apparatus for molding roofing panels having a stepped portion by the dry method, the roofing panels comprising a main body and an offset insert portion having the same thickness or desired different thicknesses.

Another object of this invention is to provide an apparatus for molding roofing panels of the type described above in which the junction between the main body and the insert portion is tapered on its inner side to reinforce the junction.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front view showing a molding apparatus according to this invention;

FIG. **2** is a side elevation of the same;

FIG. **3** is a fragmentary front view of the apparatus showing the construction of FIG. **1** as simplified for a better understanding of the apparatus;

FIG. **4** is a perspective view showing a lower die and a movable hopper;

FIG. **5** is a view in section taken along the line V–V in FIG. **6**;

FIGS. **6** to **8** are views illustrating the movement of the lower die, the movable hopper, an upper die and a frame in the course of molding operation;

FIG. **9** is a perspective view showing a roofing panel having a stepped insert portion; and

FIG. **10** is a view in vertical section taken along the center line of the panel shown in FIG. **9**.

DETAILED DESCRIPTION OF THE INVENTION

The apparatus shown is adapted to mold archlike roofing panels each including a main body **2**, an insert portion **4** extending stepwise from one end of the main body **2** as seen in FIGS. **9** and **10**. A lower die **8** is disposed above a machine bed **6**. A top plate **12** mounted on upper portions of posts **10** is provided with a hydraulic piston-and-cylinder assembly **14** which raises and lowers an upper die **16** attached thereto.

The upper die **16** has arched molding faces **18** and **20** conforming to the curved shapes of the insert portion **4** and tne main body **2** of the panel respectively. The junction between the molding faces **18** and **20** is tapered as at **22**.

The lower die **8** is divided, at the portion thereof corresponding to the position indicated at the two-dot-and-dash line in FIGS. **9** and **10** into two, namely as insert portion die segment **26** for molding the panel insert portion **4** and part of the panel main body **2**, and a main body die segment **28** for molding the remainder of the panel main body **2**. As seen in FIGS. **1** and **3**, the insert portion die segment **26** is fixed to the machine bed **6**. The main body die segment **28** is connected to the forward end of the piston of hydraulic means **30** supported by the machine bed **6** and is movable upward and downward.

The posts **10** slidably carry bolsters **36** provided with two brackets **32** and **34** extending rearward and forward respectively. Connecting plates **38** each interconnecting each pair of the bolsters **36** are connected by rods **44** to a connecting plate **42** on the forward ends of the pistons of hydraulic cylinders **40** supported by the machine bed **6**. The hydraulic piston-and-cylinder assemblies **40**, when operated, raise or lower the two brackets **32** and **34** at the same time.

A frame **46** fitting around the insert portion die segment **26** and main body die segment **28** is movable upward and downward independently of the segments **26** and **28**. The frame **46** is attached to the connecting plates **38** of the bolsters **36** and is upwardly and downwardly movable with the brackets **32** and **34**.

Disposed above the bracket **32** close to the insert portion die segment **26** is a feeder chute **48** for feeding the material for roofing panels. An apron **50** is positioned below and opposed to the feeder chute **48**. A movable hopper **52** for carrying the material fits in the apron **50**.

Two parallel rails **54** extend between and supported by brackets **32** and **34**. The movable hopper **52** is provided on its opposite sides with wheels **56** supported on the rails **54**. Reciprocal drive means **58**, such as a hydraulic piston-and-cylinder assembly, mounted on the bracket **32** is coupled to the movable hopper **52** to reciprocally drive the hopper **52** between the feeder chute **48** and the lower die **8**.

As shown in FIGS. **3** and **4**, the movable hopper **52** comprises a rectangular frame open at its top and bot-

tom and scrapers **62** disposed in its interior and at the front and rear ends thereof. The scrapers **62** conform to the cross sectional form of the cavity **60** of the insert die segment **26** but are smaller than the cross sectional size of the cavity **60** by the thickness of the material to be accumulated therein. The hopper **52** has a longitudinal dividing plate **64** extending centrally thereof and is provided at its front end with an upwardly and downwardly movable scraping plate **66** for scraping off an excess of the material. Drive means **68**, such as an electromagnet, coupled to the scraping plate **66** lowers the scraping plate **66** at a suitable time.

The other bracket **34** carries thereon reciprocally movable means **70** for withdrawing molded panels. The withdrawing means **70** comprises a hollow vacuum box **72** having contours conforming to the inside shape of molded roofing panels and formed in its opposite sides with suction apertures **74**. The aperture is surrounded by a pad. The box **72** is provided on its opposite sides with wheels **76** supported on the rails **54** and is coupled to drive means **78**, such as a hydraulic piston-and-cylinder assembly, which reciprocally drives the box **72** between the lower die **8** and the bracket **34**.

As shown in FIGS. **4** and **5**, the lower die **8** has vertical sides fitting in the vertically movable frame **46** and cavities conforming to the outside contours of the roofing panel to be formed. More specifically, the insert portion die segment **26** is provided with a cavity **84** conforming to the shape of the panel insert portion **4** for forming the insert portion and with a short cavity **86** conforming to the shape of the panel main body **2** for forming part of the main body **2**, the cavity **86** being positioned at one end of the insert portion forming cavity **84**. The main body die segment **28** is formed with a cavity **80** conforming to the shape of the panel main body **2**.

The frame **46** is formed in its front and rear end walls with cutouts **88** and **90** conforming to the shape of the scrapters **62** on the movable hopper **52**. The hopper **52** is movable over the lower die **8** and the frame **46**.

OPERATION

When the material is fed to the lower die **8**, the main body die segment **28** is held in its raised position, and the bottom of the segment **28** defining the cavity **80** is positioned at the same level as the bottom of the insert portion die segment **26** defining the cavity **84**. Accordingly the upper edges **94** of the main body cavity **28** are positioned at a level which is higher by the amount of offset **82** of the insert portion **4** than the upper edges **96** of the insert portion die segment **26**. With the frame **46** also in its raised position, the bottom surfaces of the frame **46** defining the cutouts **88**, **90** and the upper edges **98** of the frame **46** are positioned at levels which are higher by the thickness **100** of the layer of the material to be accumulated in the die **8** than the upper edges **94** of the main body die segment **28**.

The feeder chute **48** feeds the material into the movable hopper **52** which is located immediately below the chute, namely into the spaces defined by the apron **50** and the scrapers **62**. The material is a powdery to granular mixture of cement and pumice, foamed siliceous sand or like inorganic foamed aggregate and is wetted with 3 to 15% by weight of water based on the mixture.

Subsequently the drive means **58** advances the movable hopper **52** over the cutout **88** of the frame **46** as shown in FIG. **6**, with the scraping plate **66** in its raised position, feeding the material from the spaces between the scrapers **62** into the cavities **60** and **80** of the lower die **8**. Since the movable hopper **52** travels as supported on the rails **54**, the lower ends of the scrapers **62** come into contact with the bottom face of the frame **46** defining the cutout **88** and are maintained at a constant distance above the bottom faces of the die segments **26**, **28** defining the cavities **60**, **80**. The material is therefore accumulated in the cavity **80** as well as on the upper edges **94**, **96** to a predetermined thickness. The hopper **52** passes over the lower die **8** and advances to the other cutout **90** of the frame **46** or further to an apron **102** in front of the frame **46**, thus feeding the material into the die cavities **60** and **80**. The drive means **58** thereafter retracts the movable hopper **52**.

With the backward travel of the hopper **52**, the scrapers **62** scrape off an excess of the material fed to the die cavities of the lower die **8**, thus leaving a layer of the material in the die cavities **60**, **80** and over the upper edges **94**, **96** in a thickness (25 to 35 mm) equal to the clearance between the outer periphery of the scrapers **62** and the bottom surfaces defining the cavities **60**, **80**. When the front end of the hopper **52** retracts to the location of the insert portion die segment **26** after passing over the main body die segment **28**, an unillustrated sensor actuates the drive means for the scraping plate **66** to lower the plate **66**, causing the plate **66** to scrape off the material from the upper edges **96** of the insert die segment **26** by an amount corresponding to the amount of the offset **82** of the insert portion **4** as shown in FIG. **7**. As a result, the same thickness of material is left accumulated on the upper edges **96**, **94** of the two die segments **26**, **28**.

Upon retraction of the movable hopper **52** to the position immediately below the feeder chute **48**, the hopper **52** is retained in this position for the next feeding operation with the scraping plate **66** returned to its raised position.

The upper die **16** is lowered into the lower die **8** and compresses the material placed in the cavities **60** and **80**. Almost simultaneously with the downward stroke of the upper die **16**, the hydraulic piston-and-cylinder assembly **30** supporting the main body die segment **28** operates, lowering the segment **28** by the amount of offset **82** of the panel insert portion **4**, with the result that the upper edges **94** and the bottom face of the segment **28** defining the cavity **80** become flush with the upper edges **96** of the insert portion die segment **26** and the bottom face thereof defining the main body forming cavity **86** at its one end. Consequently the material filling the cavity **86** partially flows into the cavity **80** of the die segment **28**, and a slanting accumulation of the material is formed in the main body forming cavity **86**. (see FIG. **8**.)

The upper die **16** compresses the accumulation of the material in the two die cavities **60** and **80** at high pressure of 200 to 600 kg/cm^2 for several seconds to such an extent that the foamed aggregate contained in the material will not lose its porosity.

The hydraulic piston-and-cylinder assemblies **40** supporting the frame **46** thereafter operate, lowering the frame **46** to a position slightly lower than the upper edges **94** and **96** of the lower die **8**. The upper die **16** is then raised to its original position, whereupon the molding formed by compression spontaneously releases itself from the die segments **26** and **28** by virtue of the expansion of the pores in the material.

After the rise of the upper die **16**, the drive means **78** on the bracket **34** operates, driving the vacuum box **72**

to a position above the molded panel in the lower die **8** to bring the box **72** into fitting engagement with the curved surface of the panel. The box **72** exerts suction on the panel, which in turn comes into intimate contact with the pads surrounding the suction apertures **72**. The drive means **78** then retracts the vacuum box **72** with the molded panel intimately fitting thereto and withdraws the panel from the lower die **8**. The pistons of the hydraulic assemblies **40** descend again, lowering the brackets **32** and **34** to position the molded panel above a table **92**, whereupon the vacuum box **72** discontinues its vacuum action and places the molded panel on the table **92**. The parts are then raised to the original position.

With the use of the apparatus of this invention, roofing panels having a stepped portion can be molded from a mixture of cement and an inorganic foamed aggregate by the dry method. The material is fed to the lower die with the main body die segment **28** positioned at a level higher than the insert portion die segment **26** by the amount of the offset of the panel insert portion **26**, and the material is compressed with the main body die segment **28** thereafter brought to its lowered position, so that the material can be accumulated in the insert portion forming cavity **60** and the main body forming cavity **80** to the same thickness, or to different thicknesses if the raised position of the main body die segment **28** is altered. Roofing panels having a variety of stepped portions are moldable, therefore.

The present apparatus has another feature that the main body forming cavity **86**, which is formed in the insert portion die segment **26** with a greater depth than the insert portion forming cavity **84**, serves to give an increased thickness to the stepped portion of the panel which tends to have reduced strength, consequently imparting greater strength to the panel.

We claim:

1. In an apparatus for molding roofing panels having a stepped portion by placing a roofing panel material into the cavity of a lower die and lowering an upper die into the lower die to compress the material, the improvement comprising:

a lower die having cavities conforming to the outside contours of the roofing panel including a main body and an offset insert portion, the lower die being divided into a die segment for forming the main body and a die segment for forming the insert portion at a portion of the cavity for forming the insert portion,

drive means for supporting the main body die segment to raise and lower the main body die segment,

a horizontally supported hopper movable into and out of the lower die cavity and provided at its front end with a scraper smaller than the cross section of the cavity of the insert portion die segment by the thickness of the material to be accumulated therein, and

an upper die vertically movably disposed above the lower die and having a molding face conforming to the shape of the inside face of the roofing panel.

2. An apparatus as defined in claim **1** wherein the insert portion die segment is formed at an end of the insert portion forming cavity with part of the main body forming cavity, the upper die molding face being partially tapered in corresponding relation to the offset of the insert portion.

3. An apparatus as defined in claim **1** wherein the insert portion forming cavity and the main body forming cavity are each defined by an arched bottom face of the die segment.

4. An apparatus as defined in claim **1** wherein the drive means raises and lowers the main body die segment by an amount corresponding to the offset of the insert portion.

5. In an apparatus for molding roofing panels having a stepped portion by placing a roofing panel material into the cavity of a lower die and lowering an upper die into the lower die to compress the material, the improvement comprising:

a lower die having cavities conforming to the outside contours of the roofing panel including a main body and an offset insert portion, the lower die being divided into a die segment for forming the main body and a die segment for forming the insert portion at a portion of the cavity for forming the insert portion,

drive means for supporting the main body die segment to raise and lower the main body die segment,

a horizontally supported hopper movable into and out of the lower die cavity and provided at its front end with a scraper smaller than the cross section of the cavity portion of the insert portion die segment by the thickness of the material to be accumulated therein,

a frame upwardly and downwardly movably fitting around the insert portion die segment and the main body die segment and formed in each of its front and rear wall with a cutout conforming to the shape of the scraper on the movable hopper,

drive means for supporting the frame to raise and lower the frame, and

an upper die vertically movably disposed above the lower die and having a molding face conforming to the shape of the inside face of the roofing panel.

6. An apparatus as defined in claim **5** wherein the insert portion die segment is formed at an end of the insert portion forming cavity with part of the main body forming cavity, the main body die segment being upwardly and downwardly movable by an amount corresponding to the offset of the insert portion, the upper die molding face being partially tapered in corresponding relation to the offset of the insert portion.

7. An apparatus as defined in claim **6** wherein the scraper scrapes off accumulations of the material from the upper edges of the insert portion die segment by an amount corresponding to the vertical stroke of the main body die segment, the movable hopper being provided with drive means for holding the scraper in its raised position and lowering the scraper when the scraper has passed over the main body die segment during retraction of the movable hopper.

* * * * *